2.2 SRI-CAT Beamline Layout and General Description of Activities

With the completion of the construction of the sector 4 insertion device beamline, the SRI CAT now operates four insertion device lines and two bending magnet lines in four sectors. All the beamlines in sectors 1, 2 and 3 are fully operational and open to CAT members and independent investigators alike. During the last 24 months, we have hosted over 120 independent investigators on the beamlines.

Both the insertion device beamline and the bending magnet beamline have been constructed in sector 1 (see Fig. 2.1.). These beamlines were originally conceived as place of development for optics (high heat load, polarizing, high energy, etc.) and instrumentation related to time-resolved experiments. A standard APS 3.3-cm undulator (2.4 m long) is the radiation source, although we have temporarily installed a second standard undulator for high-heat-load optics testing. With the program in high-heat-load optics decreasing and the polarization program moved to sector 4, the mission of this sector has become slightly more directed. Optics development still continues, but high-heat-load testing has given way in large part to programs in x-ray interferometry and optics/instrumentation development for fourth-generation FEL sources. The major thrust in the high-energy optics program is to increase flux through the use of bent Laue monochromators. Use of the insertion device beamline for high-energy applications continues to grow, in fact to the point where we feel the time is ripe for the development of a sector devoted to the use of high-energy x-rays. This beamline continues to remain the home of the SRI CAT time-resolved program with a dispersive monochromator in place on the bending magnet beamline. An interesting synergy has emerged between the high-energy program and the time-resolved program with the application of high-energy, time-resolved powder diffraction to study phase transitions at temperatures in excess of 1000 °C.

Sector 2 (see Fig. 2.2) is the home of two of SRI CAT's strategic instruments, the hard x-ray microprobe and soft x-ray imaging programs. Two independent (collinear) insertion devices provide the radiation for those programs, a standard APS undulator for the hard x-ray activities and a one-of-a-kind 5.5-cm-period undulator for soft x-rays. This beamline is run either with the hard x–ray undulator or the soft x-ray undulator, i.e., not simultaneously. In the past, the soft x-ray beam was further split between a spectroscopy/reflectivity program and the imaging program. The spectroscopy/ reflectivity branch line was recently relocated to sector 4 thus allowing increased beam time to the flourishing x-ray microprobe and imaging programs. The x–ray microprobe and soft x-ray imaging are powerful research tools and have been applied to the study of infectious disease, drug effectiveness, contaminated environments, and integrated circuits. Recently, the x-ray microscopy program was recognized by *Research and Development* magazine with an R&D 100 award for the development of a hard x-ray scanning microprobe.

The SRI CAT inelastic x-ray scattering program resides in sector 3 (see Fig. 2.3). The program has two major components, inelastic nuclear resonant scattering (NRS) and milli-eV (meV) resolution inelastic x-ray scattering. The meV resolution team has recently completed the first phase for the development of a new 2 meV spectrometer for momentum-resolved inelastic x-ray scattering. Users have been scheduled on a regular basis on this new instrument, although further development work is still a strong component of the schedule. The pursuit for high-energy resolution continues, and a world record of 0.143 meV at 24 keV has been achieved, corresponding to a $\Delta E/E$ of less than 6×10^{-9}. This program has generated a considerable user base, and plans are now being laid out to develop a dedicated inelastic x-ray scattering sector. Beam time for inelastic NRS experiments is also heavily subscribed. Applications of NRS have been extended to the study of dynamical properties of biological materials and of materials under high pressure with the use of a Kirkpatrick Baez mirror pair that can focus the 2 meV beam to less than 5 microns. This beamline currently has two 2.7 cm undulators in the straight section, one 2.4 m in length and the other 2.0 m long. The bending magnet beamline has not been constructed on this sector.

The focus of the sector 4 program is use of polarized x-rays from 0.5 to 100 keV. This is accomplished on sector 4 through a first in synchrotron radiation technology: the operation of two independent beamlines from two canted undulators in a single storage ring straight section (see Fig. 2.4). A 270 microradian separation is introduced between the two IDs, a standard 3.3 cm undulator for the production of hard x-rays and a special CPU for the soft x-ray regime. The 3.3 cm ID is installed and operational, and we are hoping for a December installation of the CPU. X-ray polarization-based scattering studies have led to a collaboration with the microprobe scientists of sector 2 to produce a circularly polarized x-ray microprobe for the study of domains in magnetic materials, particularly buried magnetic materials. Studies of magnetic circular dichroism and magnetic roughness are also underway on sector 4. As with sector 3, the bending magnet beamline at sector 4 has not been built.

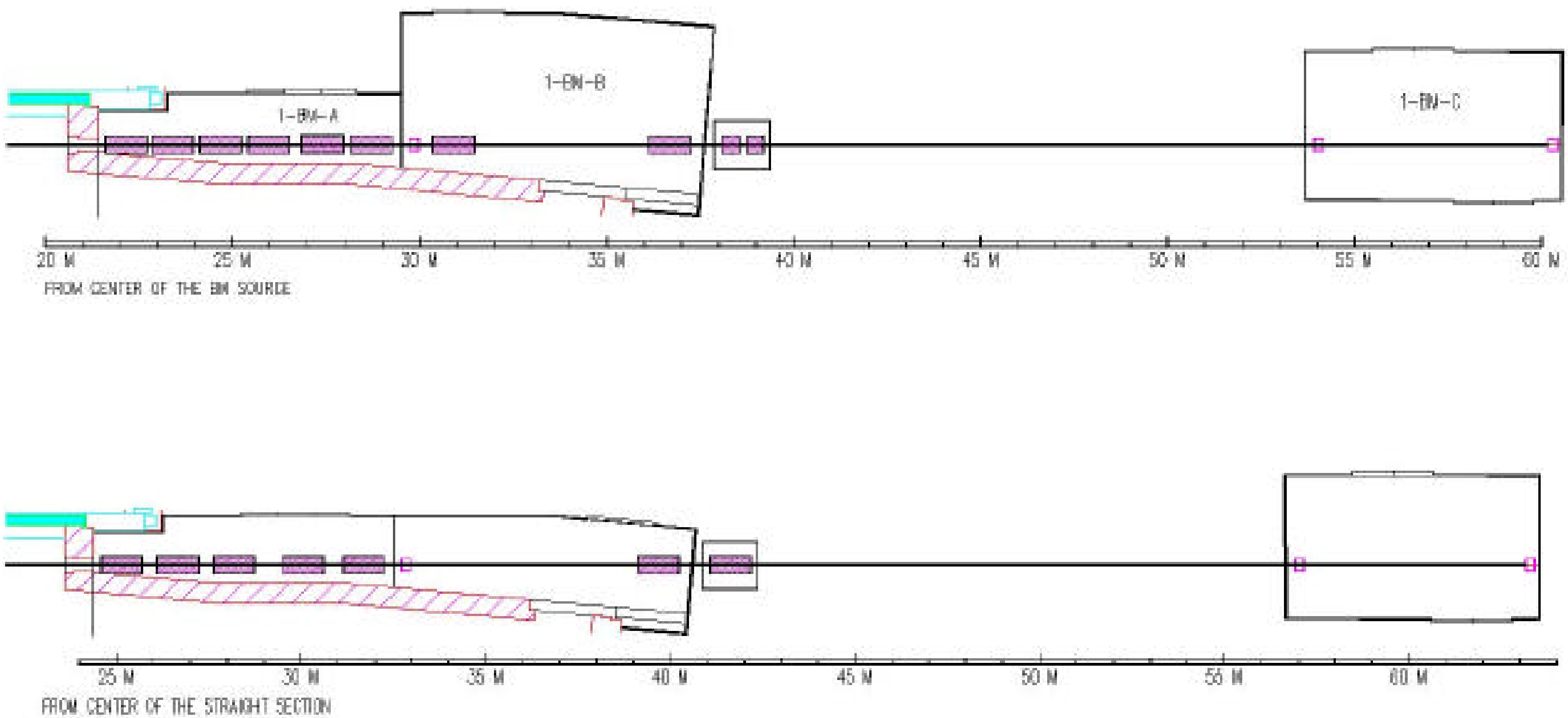

Fig 2.1. Top – General layout of bending magnet beamline at sector 1. Bottom – General layout of insertion device beamline at sector 1.

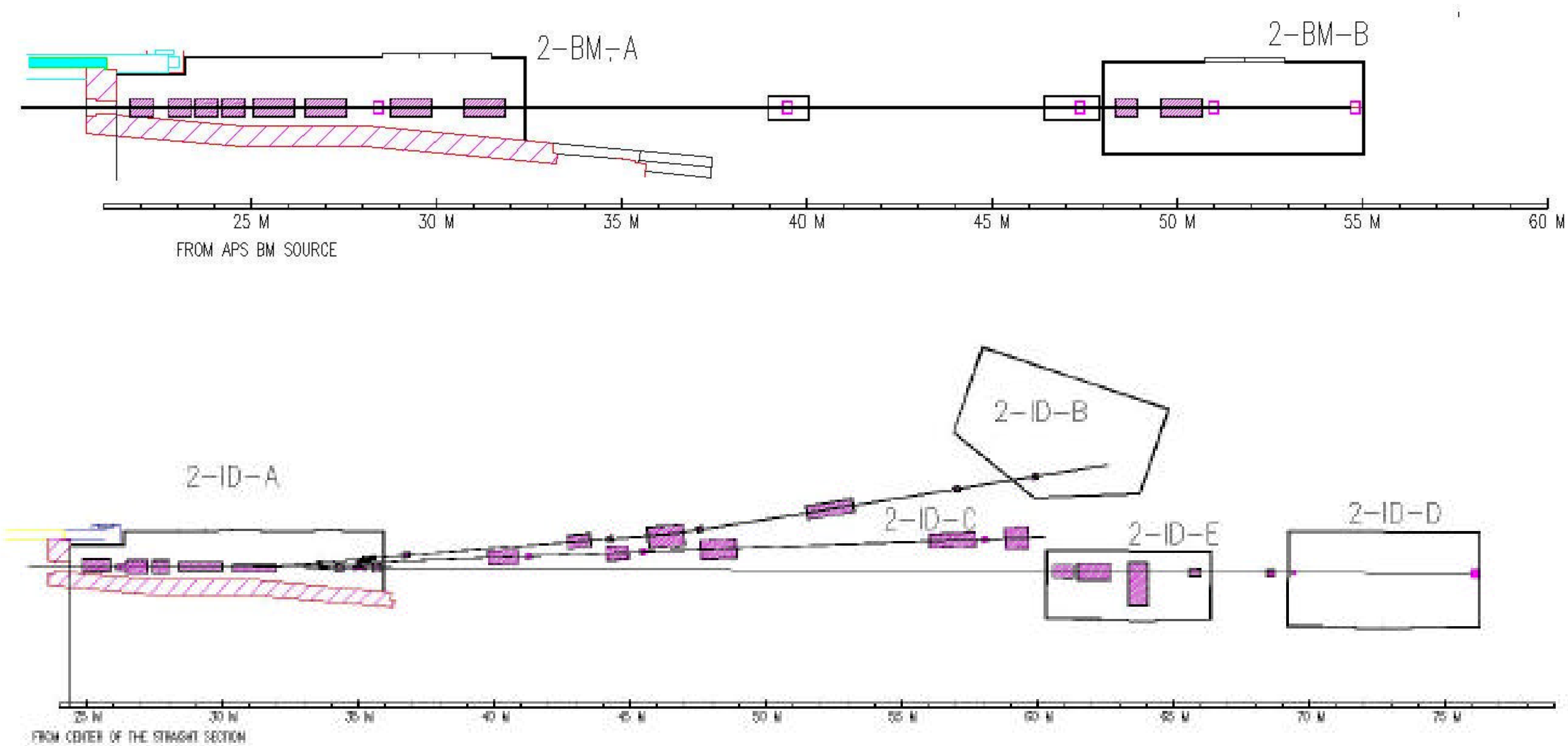

Fig 2.2. Top – General layout of bending magnet beamline at sector 2. Bottom – General layout of insertion device beamline at sector 2.

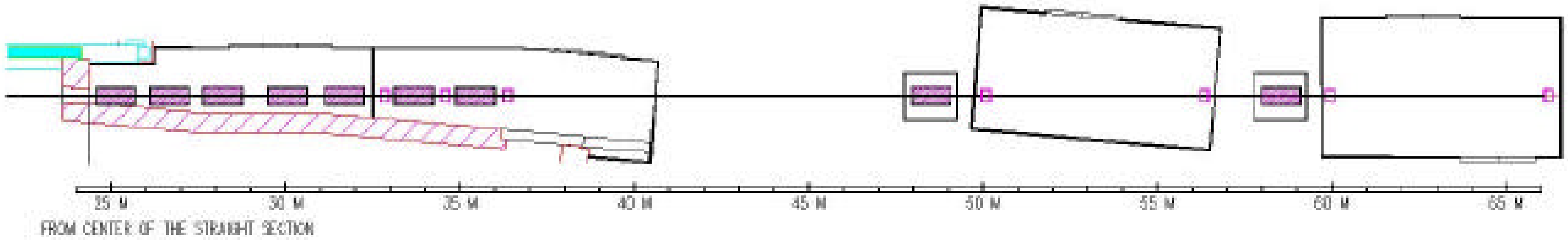

Fig 2.3. General layout of insertion device beamline at sector 3.

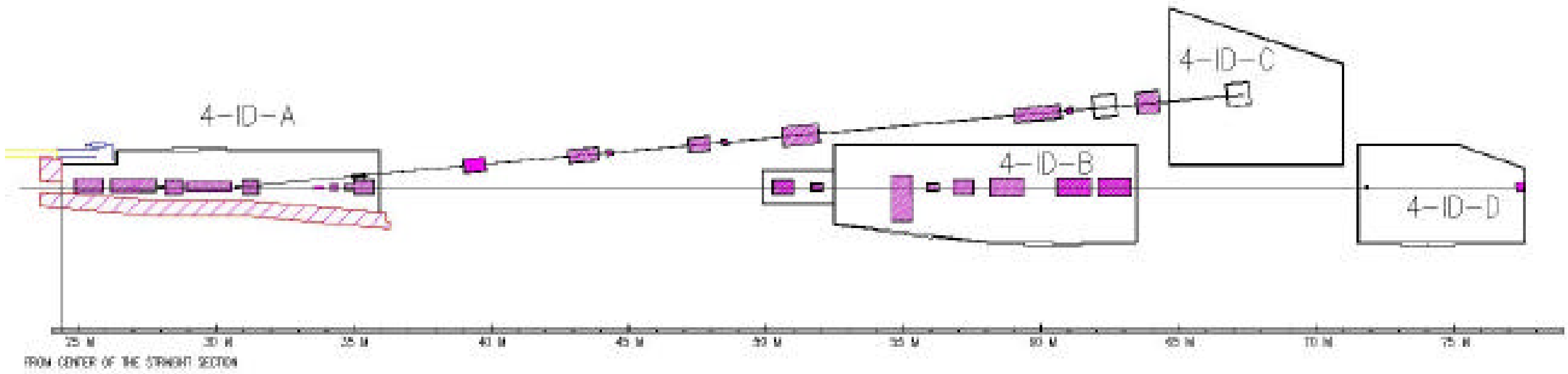

Fig 2.4. General layout of insertion device beamline at sector 4.